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28-5-16 – AN

Reg. No.

Question Paper Code : 57298

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2016

Sixth Semester

Electronics and Communication

EC 6602 – ANTENNA AND WAVE PROPAGATION

(Regulations 2013)

Time : Three Hours **Maximum : 100 Marks**

Answer ALL questions.

PART – A (10 × 2 = 20 Marks)

1. Define radiation resistance.
2. The radial component of the radiated power density of an antenna is given by $W_{rad} = a_r W_r = a_r A_o \sin \theta / r^2$ (W/m^2), where A_o is the peak value of the power density, θ is the usual spherical coordinate, and a_r is the radial unit vector. Determine the total radiated power.
3. Why antenna measurements are usually done in fraunhofer zone ?
4. The radiation resistance of an antenna is 72 Ω and the loss resistance is 8 Ω. What is the directivity (in dB), if the power gain is 15 ?
5. Define gain of an antenna. Bring out a relationship between gain and aperture of an antenna.
6. Draw the radiation pattern of an isotropic point sources of same amplitude and opposite phase that are λ/2 apart along X-axis symmetric with respect to origin.

7. On what principle slot antenna works ? Explain the principle.
8. State Rumsey principle on frequency independence.
9. Find the range of LOS system when the receive and transmit antenna heights are 10m and 100 m respectively.
10. What are the specific features of troposcatter propagation ?

PART – B (5 × 16 = 80 Marks)

11. (a) Derive the expression for the field quantities radiated from a λ/2 dipole and prove that the radiation resistance to be 73 Ω. **(16)**

OR

(b) Derive the expression for the field quantities (E and H) for a small oscillation current element. **(16)**

12. (a) Discuss the geometry of a parabolic reflector and the significance of f/D ratio. Explain its feed configurations. **(16)**

OR

(b) Discuss the construction and design of a yagi uda array. Show that the impedance of a folded dipole is 300 Ω. **(16)**

13. (a) Obtain the expression for the field and the radiation pattern produced by a N element array of infinitesimal with distance of Separation λ/2 and currents of unequal magnitude and phase shift 180 degree. **(16)**

OR

(b) (i) Using pattern multiplication determine the radiation pattern for 8 element array, separated by the distance λ/2. **(8)**

(ii) Write short notes on tapered array and phased array. **(8)**

14. (a) (i) Explain the design procedure for the construction of log periodic antenna. **(10)**

(ii) Discuss the construction equation for the helical antenna. **(6)**

OR

(b) Explain the measurement procedure for the measurement of VSWR and radiation pattern. **(16)**

15. (a) (i) In the ionospheric propagation, consider that the reflection takes place at a height of 400 km and that the maximum density in the ionosphere corresponds to a refractive index of 10 MHz. Determine the ground range for which this frequency is the MUF. Take earths curvature into consideration. **(6)**

(ii) Describe the structure of the atmosphere and explain each layer in detail. **(10)**

OR

(b) (i) Discuss the effects of earth's magnetic field on ionosphere radio wave propagation. **(8)**

(ii) Describe the troposphere and explain how ducts can be used for microwave propagation. **(8)**

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Reg. No. :

Question Paper Code : 71739

06/06/2017 FN

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2017.

Sixth Semester

Electronics and Communication Engineering

EC 6602 — ANTENNA AND WAVE PROPAGATION

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Determine the electric field intensity at a distance of 10 km from a dipole antenna of directive gain of 6 dB and radiating power of 20 kW.

2. Define gain of an antenna. Mention the relationship between gain and aperture of an antenna.

3. Using pattern multiplication find the radiation pattern for the broadside array of 4 elements, spacing between each element is $\lambda/2$.

4. Draw the radiation pattern of an isotropic point sources of same amplitude and same phase that are $\lambda/2$ apart along X axis symmetric with respect to origin.

5. What are the different types of horn antenna?

6. State Rumsey principle.

7. Mention any four advantages of microstrip antenna.

8. Draw the radiation pattern for isotropic, directional and omnidirectional antenna.

9. Define critical frequency.

10. Draw the various layers of atmospheric structure.

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PART B — (5 × 16 = 80 marks)

11. (a) Derive an expression for the power radiated by the current element and calculate the radiation resistance. (16)

Or

(b) Derive an expression for the far field component of a half wave dipole of an antenna. (16)

12. (a) (i) Explain the principle of reflector antenna and the different types of feed used in a reflector antenna. (10)

(ii) Explain the working principle of microstrip patch antenna. (6)

Or

(b) (i) A pyramidal horn antenna with the aperture length of 10 λ cm is fed by a rectangular waveguide in TE_{10} mode. Determine the design parameters of the antenna operating at 2.5 GHz. (10)

(ii) Compare the slot and dipole antenna. (6)

13. (a) Derive and draw the radiation pattern of 4 isotropic sources of equal amplitude and same phase. (16)

Or

(b) (i) Describe the principle of phased arrays and explain how it is used in beam forming. (10)

(ii) Write short notes on binomial arrays. (6)

14. (a) Design a log periodic dipole antenna to cover all the VHF TV channels from 55 MHz to 220 MHz. The required directivity is 9 dB and input impedance is 50 Ω. The elements should be made of aluminum tubing with 2.0 cm outside diameters for the largest element and the feeder line and 0.48 cm for the smallest element. These diameters yield identical (l/d) ratios for smallest and largest elements. (16)

Or

(b) (i) Show the experimental setup for measuring the unknown load impedance using VSWR method and explain. (8)

(ii) Explain the concept of electronic band gap structure and give any four applications of EBG. (8)

15. (a) Explain how the EM waves are propagated in troposphere layer and discuss the principle of troposcatter propagation. (8 + 8)

Or

(b) (i) Explain the effect of EM waves in curved earth and flat earth configuration. (8)

(ii) A mobile link has to be established between two points spaced away 1500 km via ionosphere layer of density 4.5×10^6 cm^{-3} at a height 150 km. Calculate the maximum frequency which can be communicated, critical frequency and skip distance. (8)

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(b) (i) Determine the change in the electron density of the E-layer when the critical frequency changes from 4 MHz to 1 MHz between mid-day and sun-set. (9)

(ii) A plane wave at 20 MHz is transmitted to ionosphere and reflected from a height of 500 km from the flat earth. If the refractive index corresponding to maximum electron density is 0.5, determine the horizontal range for which the signal frequency is MUF. (6)

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Question Paper Code : 52921

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2019.

Sixth Semester

Electronics and Communication Engineering

EC 6602 — ANTENNA AND WAVE PROPAGATION

(Regulation 2013)

(Common to : PTEC 6602 — Antenna and Wave Propagation for B.E.(Part-Time) Fifth-Semester – Electronics and Communication Engineering Regulations 2014)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define radiation intensity.

2. An omnidirectional antenna has uniform radiation in, $\theta = 90°$ (horizontal) plane and fall to zero outside that plane. The pattern is constant in the $\phi = 0$, (vertical) plane in the range $60° \leq \theta \leq 120°$. Find the directivity.

3. Write any two differences between slot antenna and its complementary dipole antenna?

4. List the different methods of feeding Microstrip antenna.

5. Draw the radiation pattern for a linear array of two isotropic elements spaced $\lambda/2$ apart and with equal current fed in phase.

6. What is tapering of arrays?

7. Define pitch angle of a helical antenna.

8. What is the need for an Anechoic chamber?

9. What is meant by fading?

10. Determine the maximum range of a Tropospheric transmission for which the transmitting antenna height is 100 m and receiving antenna height is 10 m.

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PART B — (5 × 13 = 65 marks)

11. (a) (i) Design a Yagi-Uda array antenna for 145 MHz frequency that has a directivity of 12 dB with six directors Determine the total length of the array Explain its principle of operation. (7)

(ii) The radiation intensity of an antenna is given by $U(\theta) = \cos^4\theta$, $(0^\circ \le \theta \le 90^\circ, 0^\circ \le \phi \le 360^\circ)$. Find

(1) half-power beam width (HPBW) (3)

(2) first-null beam width (FNBW)

(iii) Sketch the radiation pattern of dipole antenna for the following lengths

(1) 0.25 λ

(2) 1.0 λ

(3) 1.5 λ. (3)

Or

(b) (i) Determine the directivity of a halfwave dipole. (8)

(ii) A transmitting antenna has an effective height $2/\pi$ times the physical length. This carries a current of 1600 Amps at the base and operating at a frequency of 20 KHz. If the physical length of the antenna is 200 metres and antenna efficiency is 10%. Calculate

(1) Electric field intensity at 350 km

(2) Radiation resistance

(3) Power radiated

(4) Power input in the antenna

(5) The voltage induced in the receiving antenna of 100 metres effective height at a distance of 350 km. (5)

12. (a) Discuss the principle working of Parabolic reflectors. Explain the various feed techniques their relative merits and demerits. Discuss the role of f/d ratio in the parabolic reflectors (f-focal length, D-diameter of reflector). (13)

Or

(b) Explain the principle operation of horn antenna and discuss the various forms of Horn antenna. Obtain the design equations of Horn antenna.(13)

13. (a) (i) Arrive the array factor of a two-element array. For this array, Find the nulls of the total field when $d = \lambda/4$ and the cases $\beta = 0$, $\beta = 90^\circ$ and $\beta = -90^\circ$. (9)

(ii) Define uniform linear array and grating lobes (4)

Or

(b) (i) Explain pattern multiplication. Using the principles of pattern multiplication determine the radiation pattern for eight element linear array, and spaced $\lambda/2$ apart with equal currents fed in-phase. Specify the limitations of this method. (8)

(ii) Obtain the excitation coefficients of a nine element binomial array. (5)

14. (a) With suitable diagram, explain the construction and principle operation of log periodic antenna. (13)

Or

(b) Explain the measurement procedure for gain and VSWR. (13)

15. (a) (i) Derive an expression for the refractive index of the ionosphere in terms of electron number density and frequency. (8)

(ii) Explain the terms : Duct propagation and multi hop propagation. (5)

Or

(b) (i) Describe the significant features of ground wave propagation. (4)

(ii) Explain with the help of suitable sketch, the concept of skip distance and its relation to maximum usable frequency. (9)

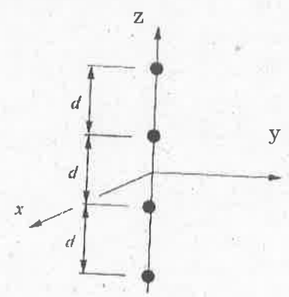
PART C — (1 × 15 = 15 marks)

16. (a) A four-element uniform array has its element placed along the z axis with distance $d = \lambda/2$ between them according to the figure below

(i) Derive the array factor and show that it can be written as $\frac{\sin(2\psi)}{\sin(\psi/2)}$, where ψ is the progressive phase shift between the elements. (6)

(ii) In order to obtain maximum radiation along the direction $\theta = 0^\circ$ where θ is measured from the positive z axis, determine the progressive phase shift ψ. (3)

(iii) Find all the nulls of the array factor. (6)



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Question Paper Code : 80347

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2016.

Sixth Semester

Electronics and Communication Engineering

EC 6602 — ANTENNA AND WAVE PROPAGATION

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is meant by retarded potential?
2. The voltage induced by the application of an electric field of strength 2 Volts/meter is 0.7. Calculate the effective length of the element.
3. Draw the different types of horn antennas.
4. Name some numerical tools that can be used to analyze an antenna.
5. How can we eliminate minor lobes?
6. What is the basic principle of antenna synthesis?
7. State Rumsey's principle.
8. Compare and contrast wedges and pyramids.
9. Find the critical frequency of an ionosphere layer which has an electron density of 1.24×10^6 cm^{-3}.
10. What is meant by duct propagation?

PART B — (5 × 16 = 80 marks)

11. (a) Explain the principle of radiation from an oscillating electric dipole. Derive the near field and far field expressions. (16)

Or

(b) Derive the expressions for the fields at a far point due to a half wave dipole. (16)

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12. (a) Explain in detail the radiation from a slot antenna and their feed systems. (16)

Or

(b) Explain the radiation mechanism of reflector antennas and their feed systems. (16)

13. (a) Derive and plot the radiation from a broadside array of 4 point sources. (16)

Or

(b) (i) Discuss in detail the concept, design principles and types of phased array. (10)

(ii) What is the significance of binomial array? (6)

14. (a) (i) Explain the operation and design of a helical Antenna. (10)

(ii) Explain the procedures involved in the measurement of gain in antennas. (6)

Or

(b) Explain in detail about log periodic antennas. What is the need for feeding from end with shorter dipoles and the need for transposing the lines? Also discuss the effects of decreasing α. (16)

15. (a) Draw the electron density profile chart of an ionosphere and explain. Also derive an expression for the effective relative dielectric constant of the ionosphere. Explain about reflection and refraction of waves in ionosphere. (16)

Or

(b) (i) Explain the attenuation characteristics for ground wave propagation. (8)

(ii) Explain LOS propagation and troposcatter propagation. (8)

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Question Paper Code : 50448

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2017
Sixth Semester
Electronics and Communication Engineering
EC 6602 – ANTENNA AND WAVE PROPAGATION
(Regulations 2013)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions :

PART – A **(10×2=20 Marks)**

1. An antenna has a field pattern given by $E(\theta) = \cos^2(\theta)$ for $0° \leq \theta \leq 90°$. Find HPBW.

2. Differentiate Rádian and Steradian.

3. State Babinet's principle.

4. What are secondary antennas ? Give two examples.

5. State pattern multiplication.

6. What is tapering of arrays ?

7. For a 20 turn helical antenna operating at 3GHz with circumference C = 10 cm and the spacing between the turns 0.3λ, calculate the directivity and half-power beam width.

8. What is a frequency independent antenna ?

9. The critical frequency for an ionised layer is 5 MHz. Determine the electron density of the layer.

10. Define skip distance.

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PART – B (5×16=80 Marks)

11. a) i) Draw a neat sketch of a 3 element Yagi-Uda antenna and explain its principle of operation. (12)

ii) Two half-wave vertical dipole antenna each with a gain of 1.64 are horizontally separated by a distance 100 km to form a transmitter – receiver link. The transmitter feeds its antenna with 10 W at 100 MHz. Calculate the power received by the other antenna. (4)

(OR)

b) Derive the field equations for an oscillating dipole starting from Maxwells equations. Derive the expression for its radiation resistance. (16)

12. a) i) Explain the principle of parabolic reflector antenna and discuss on different types of feed used with neat diagram. (12)

ii) The diameter of a parabolic reflector is 2m. For operation at 6GHz, find the beam width between first nulls and the gain. (4)

(OR)

b) Write short notes on :

i) Slot antenna. (8)

ii) Microstrip antenna. (8)

13. a) Derive the expression for the array factor of a linear array of four isotropic element spaced $\lambda/2$ apart fed with signals of equal amplitude and phase. Obtain the directions of maxima and minima. (16)

(OR)

b) i) Explain in detail the Binomial array and derive an expression for the array factor. Also obtain the excitation coefficients of a seven element binomial array. (14)

ii) What is phased array ? (2)

14. a) Design a 50 to 200MHz log periodic dipole antenna for gain corresponds to scale factor 0.8 and space factor. 0.15. Assume the gap spacing at the smallest dipole is 3.6 mm. (16)

(OR)

b) With a neat block diagram, explain the radiation pattern and gain of an antenna can be measured. (16)

15. a) Describe the structure of the atmosphere and specify the factors affecting the radio wave propagation. (16)

(OR)

b) i) Discuss briefly on the types of fading. (7)

ii) Obtain an expression for the refractive index of an ionospheric layer. (9)

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28/11/18 FN

Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 20422

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2018.

Sixth Semester

Electronics and Communication Engineering

EC 6602 – ANTENNA WAVE PROPAGATION

(Regulations 2013)

(Also common to : PTEC 6602 – Antenna Wave Propagation for B.E. (Part – Time) Fifth Semester Electronics and Communication Engineering Regulations – 2014)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Calculate the radiation resistance of a $\lambda/10$ wire dipole in free space.

2. The radiation resistance of an antenna is $72\,\Omega$ and loss resistance is $8\,\Omega$. What is the directivity in dB if the power gain is 16?

3. State Babinet's principle applied to slot antennas.

4. Draw the diagram representing rectangular microstrip antenna. List the substrates used for microstrips antenna.

5. What is binomial array? What are the disadvantages of binomial array?

6. What is meant by uniform linear array?

7. Write Friss transmission formula and define the parameters in it.

8. What are near and far field measurements?

9. Two points on earth are 1500 km apart and are to communicate by means of HF. For a single hop transmission, the critical frequency is 7 MHz. Calculate maximum usable frequency for those two points, if the height of the ionosphere layer is 300 km.

10. What do you mean by fading?

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PART B — (5 × 13 = 65 marks)

11. (a) (i) A 1.83 m paraboloid reflector is to be used at 6 GHz. Calculate the beamwidth between the first nulls. Also calculate the gain of the antenna and express it in decibels. (6)

(ii) Define the term "directivity gain. Derive the relation between the gain of an antenna and the antenna aperture. (7)

Or

(b) Write short notes on (i) reciprocity theorem (ii) Beam solid angle (iii) Front to back ratio (iv) self impedance of an antenna (v) half power beam width (vi) polarization (vii) directivity (viii) principal patterns.

12. (a) (i) Find the dimensions and terminal resistance of a complementary slot for a cylindrical dipole with length to diameter ratio of 28 and length of 0.925λ having terminal impedance of 710 + j0 ohms. (5)

(ii) Explain in detail about radiation mechanism of slot antenna and derive the impedance of a Infinitesimally thin $\lambda/2$ slot antenna. What are the differences between slot and its complementary antenna. (8)

Or

(b) (i) Write short notes on microstrip antenna. List the advantages and disdvantages of microstrip antenna. Discuss the ways to improve the bandwidth of microstrip antenna. (10)

(ii) Explain the different feeding techniques for micostrip antenna. (3)

13. (a) Derive the field equations for array of two point sources with spacing $\lambda/2$ with equal amplitude and phase. Also derive the array factor, direction of maximum, minimum and half power point directions. Draw the radiation pattern.

Or

(b) (i) Discuss the properties of linear broadside array. (7)

(ii) A linear broadside array consists of four equal isotropic inphase point sources with $\lambda/3$ b spacing (overall length of the array = λ). Calculate the directivity, BWFN, HPBW. (6)

14. (a) Describe how the radiation pattern and gain of a given antenna can be measured experimentally. (13)

Or

(b) Discuss about (i) electronic bandgap structures and its applications (ii) Helical antenna under axial and normal mode of operation. (13)

15. (a) Explain briefly the terms skip distance, maximum usable frequency and virtual height as used in ionospheric propagation.

Or

(b) Write short notes on: (i) Tropospheric propagation (ii) Troposcatter propagation (iii) Ground wave propagation and its advantages, disadvantages.

PART C — (1 × 15 = 15 marks)

16. (a) Using reciprocity principle, show that the radiation pattern of an antenna is same in both transmit and receive mode.

Or

(b) Discuss about modern antennas and their applications.

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3/12/19/FN

Reg. No. :

Question Paper Code : 91456

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019
Sixth Semester
Electronics and Communication Engineering
EC 6602 – ANTENNA AND WAVE PROPAGATION
(Regulations 2013)
(Common to PTEC 6602 – Antenna Wave Propagation for B.E. (Part-Time) – Fifth Semester – Electronics and Communication Engineering)
(Regulations 2014)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. A radio link has a 20W transmitter connected to an antenna of 2.5m² effective aperture at 5GHz. The receiving antenna has an effective aperture of 0.5m² and is located at a 15km line of sight distance from the transmitting antenna. Assuming lossless, matched antennas, find the power delivered to the receiver.
2. Draw the field lines of radiation from λ/2 dipole antenna.
3. Draw various types of Horn antenna.
4. Define Babinet's principle.
5. Find the minimum element spacing of a 10 element linear uniform broadside array of isotropic radiators to achieve 7dB directivity.
6. What is Binomial array ?
7. Define Reconfigurable antenna and Active antenna.
8. List the advantages of dielectric antenna.
9. Two points on the earth are 1500km apart and are to communicate by means of HF. For a single hop transmission, the critical frequency at that time is 10 MHz. Calculate the MUF for those two points if the height of the ionospheric layer is 300 km.
10. Define skip distance.

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PART – B **(5×13=65 Marks)**

11. a) i) With neat diagram, explain about Yagi-Uda antenna. **(7)**

ii) An antenna has a field pattern given by $E(\theta) = \cos\theta \cos 2\theta$ for $0° \leq \theta \leq 90°$. Find Half Power Beam Width (HPBW) and Beam Width Between First Nulls (FNBW). **(6)**

(OR)

b) Explain in detail about fields of short dipole and derive the expression for its impedance of free space.

12. a) i) Compare uniform and tapered aperture antennas. Give examples. **(3)**

ii) With neat diagram, explain parabolic reflector antenna and its Cassegrain feeding system. **(10)**

(OR)

b) i) Explain the radiation mechanism of Microstrip antenna. **(6)**

ii) Write short notes on Slot antennas. **(7)**

13. a) i) What are broadside and end-fire array ? **(3)**

ii) Derive the expressions for field pattern and array factor of n isotropic point sources of Broad side array. **(10)**

(OR)

b) Briefly explain the following antenna arrays.

i) Phased Arrays. **(6)**

ii) Adaptive Arrays. **(7)**

14. a) i) Explain about helical antenna and its modes of operation. Derive the expressions for pitch angle. **(8)**

ii) A 10 turn helix is constructed at 8GHz with a circumference of 3.45 cm and a pitch angle of 15°. Find the HPBW and gain. **(5)**

(OR)

b) Describe the experiment set up for the measurement of the following :

i) Radiation pattern. **(6)**

ii) VSWR. **(7)**

15. a) Write short notes on :

i) Ground wave propagation. **(4)**

ii) Duct propagation. **(4)**

iii) Troposcatter propagation. **(5)**

(OR)

b) Explain how earth's magnetic field affects the propagation of radio waves in the ionosphere. Discuss its effects on Refractive index and absorption of radio waves.

PART – C **(1×15=15 Marks)**

16. a) i) What is Log periodic antenna ? Explain the design principle of Log periodic antenna. **(9)**

ii) Design a 50 – 200 MHz Log-periodic antenna to obtain a gain corresponds to scale factor 0.8 and space factor 0.15. **(6)**

(OR)

b) Explain with the aid of a diagram, how multi-path transmission can arise of a long distance high frequency point to point service ? What steps can be taken to minimize the effects of multi-path transmission ? Explain how the D-layer and sporadic E layer affect long distance radio communication. **(15)**

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